Evaluating Education: Analyzing Pre-Service Teachers' Assessments in Light of Equity Pedagogy and Mathematical Practices

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Background and Purpose

The **purpose** of the research is to investigate pedagogical practice connections made by pre-service teachers between the Common Core Standards for Mathematical Practices and Equity Pedagogy. This agenda is in response to a call from the national mathematics education research community to pursue such connections. The field of mathematics education has come to a focus on equity through various routes and over multiple decades. The National Council of Teachers of Mathematics (NCTM) released the Curriculum and Evaluation Standards for School Mathematics in 1989, where they led the field with the inclusion of equity; and their Principles and Standards in 2000, where equitable practices are included. However, although some mathematics education scholars have progressed the field in terms of addressing equity and pedagogy (e.g. Joseph, 2013), what is still lacking is a way to connect the demands of the curriculum (such as state standards based on the Common Core for Mathematics) and the implications of the Common Core Mathematical Practices; with teachers' understanding of pedagogical practices focused on an equity agenda. Most recently, Bartell et al. (2017) have put forth a call to the mathematics education research community to pursue inquiry around such connections, particularly focused on equity pedagogy and the Common Core Mathematical Practices. Since it is the mathematics practices that distinguish the Common Core from previous state and national standards, the pursuit of this inquiry is timely.

Procedure

Subjects: Individual pre-service teachers were surveyed from an Early Childhood Education program at a regional campus of a large Research I institution.

Measurement/Instrumentation: A survey tool developed by the researcher for a prior project (Erchick, 2009) is one of the two instruments used in this research. The second is a set of reflective response prompts contributed to the pre-service program by the researcher.

1. Learning about Mathematics and Pedagogy (LAMP) survey tool. This survey is composed of forced response and narrative item explanations for the forced response selections centered on 10 examples of children's mathematical work samples. The items in the LAMP survey are included in a PDF with this proposal; and

2. Reflective Prompts: These prompts invited students to reflect upon their own growth or lack thereof.

Data Analysis: To analyze the data, the researcher coded responses to one of the LAMP mathematical work samples with codes that identify selections in the data as representing one or more of Joseph's (2013) Equity Pedagogy Categories (EPC), one or more of the Common Core Mathematical Practices (CCMP) (2010), or as representing both the EPC and the CCMP. The researcher also coded the responses based on if a response was in direct opposition to the EPC or the CCMP, representing this with an X after the individual code. The codes corresponding with the EPC and the CCMP are detailed in the Codes section.

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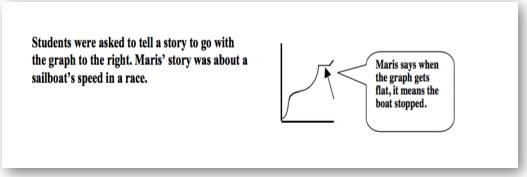
The Problem



The problem chosen from the LAMP survey for this analysis is a problem that centers on the idea of rate. The pre-service teachers were provided with the above information, and they were then asked how they would represent what Maris understands and does not understand from Maris' response to the problem. The teachers were also asked what next steps they would take to further Maris' understanding of the material.

Seeing as there are no labels on the axes of this graph and the instructions to the students were very open-ended, there are a number of ways in which Maris' idea could be interpreted. For instance, Maris could have considered the x-axis as representing time and the y-axis as representing distance. This would still represent speed, which is the ratio of distance traveled over time, and would make Maris' explanation valid. Another interpretation would be that Maris was attempting to represent speed over time, with time as the x-axis and speed as the y-axis. This would make Maris' explanation incorrect because a flat line on the graph would represent a constant speed. A knowledge of the content and a thorough analysis of the problem are both required in order for a reader to realize these multiple possible interpretations.

Codes

Equity Pedagogy (EPC)

ETL : **E**xplicit **T**alk about the meaning and use of mathematical **L**anguage
ETR : **E**xplicit **T**alk about ways of **R**easoning
ETMP : **E**xplicit **T**alk about **M**athematical **P**ractices
EST : **E**xplicit **S**tudent **T**asks and work
IT : Quality of **I**nstructional **T**ime spent on mathematics
EDC : **E**ncouragement of a **D**iverse array of mathematical **C**ompetencies
AU : **Au**tonomous student work opportunities
RWP : **R**eal-**W**orld **P**roblems or examples
ESE : **E**mphasis of **S**tudent **E**ffort and message that effort will eventually pay off
EE : **E**xpressed **E**xpectation that everyone will be able to do the work
OCK : **O**pportunity for **C**o-construction of **K**nowledge
SVA : Fore-grounding **S**tudent Voice and **A**gency
EMT : **E**xplicit attention to **M**utual **R**espect
ECT : **E**ncouraging **C**ritical **T**hinking

Mathematical Practices (CCMP)

MSP : **M**ake **S**ense of problems and **P**ersevere in solving them
RAQ: **R**eason **A**bstractly and **Q**uantitatively
CACR : **C**onstruct viable **A**rguments and **C**ritique the **R**easoning of others
MM : **M**odel with **M**athematics
UTS : **U**se appropriate **T**ools **S**trategically
AP : **A**ttend to **P**recision
LUS : **L**ook for and make **U**se of **S**tructure
LER : **L**ook for and **E**xpress **R**egularity in repeated reasoning

The Results

After analyzing the data, the codes which emerged as the most common in the work of the preservice teachers were EDC and SVA, while the primary CCMP code that was revealed by the responses was CACR. There was an average of 330% more responses which were labeled as non-examples of these categories (received a code ending with an X) than those which were deemed true examples (received a code as listed in the Codes table). In terms of SVA, responders who fell in line with the non-example were not giving Maris the opportunity to voice her ideas. They appeared to be set in their ways on this problem, demonstrated a narrow view of the potential student responses, and catered their teaching strategy to adjust Maris' thinking toward this singular view. EDC is similar to SVA in that a diverse array of student voices are given merit in the classroom and, as a result, EDC is a code that usually pairs with SVA. In terms of CACR, oftentimes responders read the question and Maris' answer, then assumed the labels that Maris would have placed on the graph had she used them. They evaluated her work and determined a strategy for teaching her based on these assumed labels, although they had not decided to speak to Maris to fully clarify her reasoning first.

Conclusion

Results of Analysis: The data collected suggests these pre-service teachers are not instinctively choosing to seek out and give weight to the arguments of their own students. Instead, it appears that many are using a narrow perspective in approaching their own mathematical content as well as in interpreting their students' logical reasoning without input from the students themselves. In particular, the survey results suggest that the subjects of the study were struggling to demonstrate their ability to encourage input from a diverse array of mathematical competencies as well as give students voice and incorporate their ideas in future lessons. In addition, these pre-service teachers seemed to struggle with demonstrating certain mathematical practices in their assessments, including evaluating their students on their ability to construct arguments and critique those of others. We hypothesize that this could be a result of an incomplete content knowledge on the part of the pre-service teachers, or it could be related to their lack of familiarity with or understanding of equity pedagogy.

Next Steps: From here, it is possible to continue this research with additional LAMP survey questions to see if the subjects' ability to align their responses with the EPC differs based on the mathematical content. This research could also be continued by comparing pre- and post-course data to analyze the potential effects of post-secondary education courses on subjects' alignment with the EPC and the CCMP. In addition, the reflective prompts provided to the subjects at the end of their course elicited many responses that could be analyzed to gain an understanding of the teachers' perception of their own growth throughout the course.